Savannah River Site
Solid Waste Management Department
Consolidated Incinerator Facility
Operator Training Program

STACK AIR ACTIVITY MONITORING (U)

Study Guide

ZIOITX56

Revision 00

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Training Manager / Date

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Engineering / Date

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Facility Manager / Date

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REVISION LOG

REV.	AFFECTED SECTION(S)	SUMMARY OF CHANGE
01	All	New Issue

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REFERENCES

1. 261-SOP-SAAM-01, *Stack Air Activity Monitoring System*, Rev. 02, IPC 96-144 &145

2. BPF 216905, *Kurz Isokinetic Sampler*

3. Manual Q1-1 Procedure 615, *Control and Calibration of Radiation Monitoring Equipment*, Rev. 01

4. Victoreen Model 942A-200, *Manual*, 6-91

5. W825988, *Isokinetic Samplers Instrument Control Diagram*, Rev. 6

6. W836393, *Fans & HEPA Filters Instrument Arrangement Instruments*, Rev. 4

7. W836399, *Stack and Filters Inst. Arrangement*, Rev. 3

8. W836400, *Tank Farm Area Inst. Arrgmt. Sht. 1, Insts*., Rev. 10

9. W2022327, *CIF Tank Farm Isokinetic Samplers ICD Instr*., Rev. 2

10. WSRC-SA-17, *Consolidated Incineration Facility Safety Analysis Report*, DOE Approval Copy 12/95

11. ZIOISX18, *Stack Air Activity Monitor System Design Description*, Rev. 0

LEARNING OBJECTIVES

TERMINAL OBJECTIVE

1.0 Without references, **EXPLAIN** the significance of the Stack Air Activity Monitoring System to Consolidated Incinerator Facility operations, including its importance to safety, and the impact on operations of a failure of the system.

ENABLING LEARNING OBJECTIVES

1.1 **STATE** the purpose of the Stack Air Activity Monitoring System.

1.2 Briefly **DESCRIBE** how the Stack Air Activity Monitoring System accomplishes its intended purpose.

1.3 **EXPLAIN** the consequences of a failure of the Stack Air Activity Monitoring System to fulfill its intended purpose, including the effects on other systems or components, overall plant operation, and safety.

TERMINAL OBJECTIVE

2.0 Using system diagrams, **EVALUATE** potential problems which could interfere with normal Stack Air Activity Monitoring System flow paths to determine their significance on overall system operation and the corrective actions needed to return the system to normal.

ENABLING LEARNING OBJECTIVES

2.1 **DESCRIBE** the physical layout of the Stack Air Activity Monitoring System components including the general location, how many there are, power supply, and functional relationship for each of the following major components:

a. Isokinetic Samplers
b. Sample Blowers/Compressor
c. Beta/gamma Activity Monitors
d. Tritium Oxide Samplers

2.2 **DESCRIBE** the Stack Air Activity Monitoring System arrangement to include a drawing showing the following system components and interfaces with other systems:

a. Tank Farm Sampling Station
b. Offgas Sampling Station
c. Building Exhaust Sampling Station
d. Flow Control Valves
e. Active and Passive Beta/gamma Monitors
f. Tritium Sample Location
g. Tank Farm Exhaust Stack
h. Offgas Duct
i. Building Exhaust Duct

2.3 Given a description of abnormal equipment status for the Stack Air Activity Monitoring System, **EXPLAIN** the significance of the condition on system operation.

2.4 Given a description of the Stack Air Activity Monitoring System equipment status, **STATE** any corrective actions required to return system operation to a normal condition.

TERMINAL OBJECTIVE

3.0 Given values of Stack Air Activity Monitoring System operation parameters, **EVALUATE** potential problems that could effect the normal functioning of the system or its components to determine the significance of the existing condition and the actions required to return the system to normal operation.

ENABLING LEARNING OBJECTIVES

3.1 **DESCRIBE** the following major components of the Stack Air Activity Monitoring System including their functions, principles of operation, and basic construction:

a. Isokinetic Controller
b. Filter Chambers
c. Flow Detector
d. Sample Blowers/Compressors
e. Victoreen Count Rate Meter

3.2 Given values for key performance indicators, **DETERMINE** if Stack Air Activity Monitoring System components are functioning as expected.

3.3 **DESCRIBE** the following Stack Air Activity Monitoring System instrumentation including indicator location (local or Control Room), sensing points, and associated instrument controls:

a. Flow Detectors

b. Count Rate Meters

3.4 **EXPLAIN** how the following Stack Air Activity Monitoring System equipment is controlled in all operating modes or conditions to include control locations (local or Control Room), basic operating principles of control devices, and the effects of each control on the component operation:

a. Compressor

b. Sample Blowers

c. Flow Control Valves

3.5 **DESCRIBE** the High Offgas Flow interlock to include the interlock actuating condition, effects of interlock actuation, and the reason the interlock is necessary.

3.6 **INTERPRET** the following Stack Air Activity Monitoring System alarms, including the conditions causing alarm actuation and the basis for the alarms:

a. High Radiation

b. Flow Alarms

c. Monitor Fail Alarms

TERMINAL OBJECTIVE

4.0 Given necessary procedures or other technical documents and system conditions, **DETERMINE** the operator actions required for normal and abnormal operation of the Stack Air Activity Monitoring System including problem recognition and resolution.

ENABLING LEARNING OBJECTIVES

4.1 **STATE** the personnel safety concerns associated with the Stack Air Activity Monitoring System.

4.2 Given applicable procedures and plant conditions, **DETERMINE** the actions necessary to perform the following Stack Air Activity Monitoring System operations:

a. Startup

b. Shutdown

4.3 **DETERMINE** the effects on the Stack Air Activity Monitoring System and the integrated plant response when given any of the following:

a. Indications/alarms

b. Malfunctions/failure of components

c. Operator Actions

SYSTEM OVERVIEW

ELO 4.1	**STATE the personnel safety concerns associated with the Stack Air Activity Monitoring System.**

Safety

Normal operation of the Stack Air Activity Monitoring (SAAM) System presents limited safety hazards for operators. The vacuum blowers and compressors present potential noise, high temperature, and rotating machinery hazards. As with any electrical system, the potential for dangerous voltage exists when electrical leads or panels are open or exposed. Follow the safety practices as required in Manual 8Q, Employee Safety Manual.

The SAAM System is designed to detect high airborne particulate activity in the facility exhausts. In the event of a High Radiation Alarm from a detector, personnel will investigate the effected exhausts for possible faults, and RCO personnel will monitor for the spread of contamination. If the activity is above the limit (i.e. not a detector malfunction) at the exhausts, this represents a release of activity to the environment. The facility will be required to be shut down if the cause of the release is not found and corrected.

ELO 1.2	**Briefly DESCRIBE how the Stack Air Activity Monitoring System accomplishes its intended purpose.**

Introduction

The incineration process yields several by-products including process offgas. The Offgas will include gases such as nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), water (H_2O), hydrogen chloride (HCl), sulfur dioxide (SO_2), phosphorus pentoxide (PO_5), and other components such as ash particulate and radionuclides.

The HVAC system controls the air supply in the Box Handling, Kiln Feed, and Ash-out Areas, and the exhaust from the Kiln Seal Shroud. These are all in the operating areas of the CIF. Because of the ashcrete process, the ventilation system is expected to contain airborne particulate activity.

The Tank Farm stack emissions may contain radioactive materials which have been vented from one of the Tank Farm incinerator feed tanks.

The exhaust ducts for the exhaust systems are provided with High Efficiency Particulate Activity (HEPA) filters. Monitoring the CIF process offgas, the HVAC exhaust, and the Tank Farm vent is required to detect the presence of radionuclides, including tritium, which may be passed through the filters either because of their gaseous nature, or due to problems with the filtration process. Operators will need to investigate the cause of high activity levels and implement controls if necessary.

The SAAM System measures the flow rate of the exhaust systems and draws a proportionally representative sample from that exhaust for analysis. Each sample collects particulates to analyze for beta/gamma activity by an active and passive sample process, and a potion of each sample is analyzed for Tritium Oxide content.

The active sample process consists of a filter paper which collects particulate activity and a scintillation detector which measures the activity. The passive sample process consists of a filter paper in a parallel flow path with the active sample. The active and passive sample filters are collected at a minimum frequency of once a week and analyzed by RCO. The Tritium Oxide Sample is also a passive collection which is analyzed weekly by SRTC.

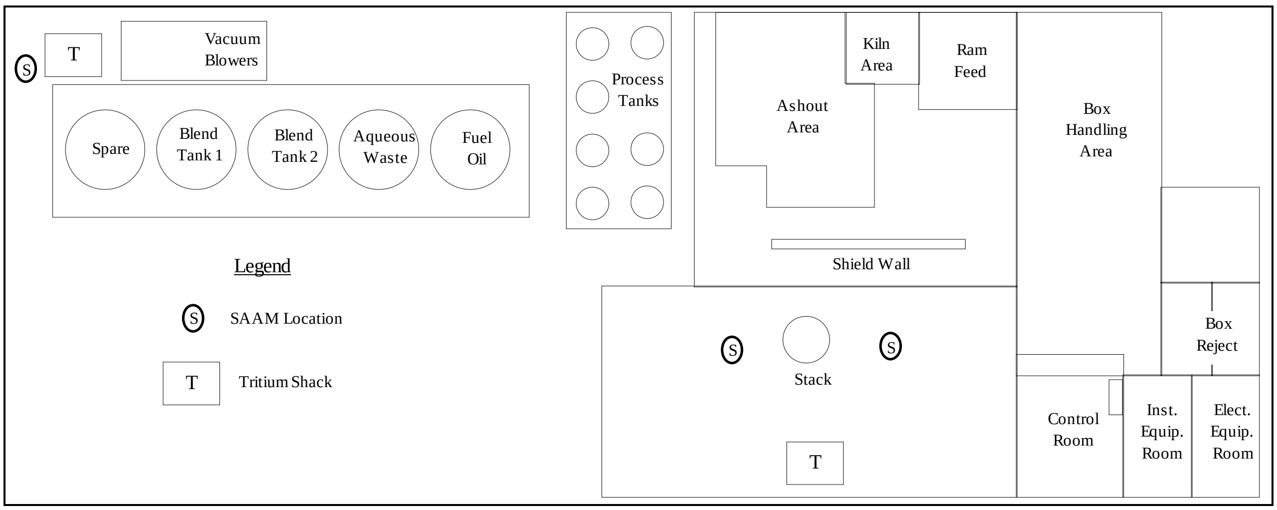

Figure 1 SAAM Locations

SYSTEM PURPOSE

ELO 1.1 STATE the purpose of the Stack Air Activity Monitoring System.

System Purpose

The purpose of the Stack Air Activity Monitoring (SAAM) System is to collect and evaluate samples from the HVAC exhaust, the incinerator process Offgas, and the Tank Farm stack emissions. Additionally, the process offgas SAAM measures combustion gas velocity in accordance with the RCRA permit. The SAAM System includes alarms for alerting operators to the presence of high levels of collected radioactivity, abnormal duct flow, and to the status of the SAAM System (flow and trouble alarms).

ELO 1.3 EXPLAIN the consequences of a failure of the Stack Air Activity Monitoring System to fulfill its intended purpose, including the effects on other systems or components, overall plant operation, and safety.

If the SAAM System is not in operation for an exhaust, any airborne particulate radiaoctive material passing through the exhaust will not be measured. Regulatory permits require that radionuclide release rate be calculated and submitted to the EPA. Therefore if the SAAM System for an exhaust is not operational, flow from the exhaust should not contain potentially radioactive particulates. To ensure this requirement is met, any time there is radioactive waste in the Tank Farm, the Tank Farm SAAM must be in operation, and any flow through the Offgas or Main Exhaust duct must be monitored following initial mixed waste incineration. The requirement for two (2) second residence time in the Secondary Combustion Chamber is ensured by a waste feed cutoff interlock provided by the Offgas flow detector. If this detector fails, waste feed will be required to be manually shut down.

DESCRIPTION AND FLOWPATH

ELO 2.2	**DESCRIBE the Stack Air Activity Monitoring System arrangement to include a drawing showing the following system components and interfaces with other systems:** **a. Tank Farm Sampling Station** **b. Offgas Sampling Station** **c. Building Exhaust Sampling Station** **d. Flow Control Valves** **e. Active and Passive Beta/gamma Monitors** **f. Tritium Sample Location** **g. Tank Farm Exhaust Stack** **h. Offgas Duct** **i. Building Exhaust Duct**

Each of the three stack sampling systems utilizes the same type of isokinetic unit to monitor air flow velocity and evaluate levels of radioactivity. The Tank Farm and HVAC systems use vacuum blowers to pull samples from their respective systems, while the Offgas system uses an air ejector in conjunction with an air compressor.

In each system two samples are collected for beta/gamma particulate analysis. Each sample is processed through a filter chamber. The active chamber collects particulate on the filter which is continuously monitored for beta and gamma radioactivity. The passive chamber collects particulate on the filter which is removed at least every seven days for laboratory analysis. The active chamber filter paper is also changed out at least once every seven days for laboratory analysis.

The air samples are exhausted back into each respective duct or stack after passing through the filter chambers.

Each sampling system also includes a Tritium Oxide sampler. The Tritium Oxide sampler inlet comes from the piping of the sample chambers of the SAAMs and is dependent on a continuous sample flow which is controlled by the operator. An absorbent will be used in the "sampler" to absorb water, for analysis. The Tritium Oxide sampler is comprised of two banks of canisters. Each bank contains seven canisters. One bank will be in operation while the other is in standby.

The HVAC and Offgas monitoring systems use a common "Tritium Shack" with separate molecular traps, while the Tank Farm has its own "Tritium Shack" with a molecular trap for collecting samples. The molecular samples are analyzed for tritium oxide by SRTC. SRTC controls access to the Tritium Shacks, and can be reached by phone at 5-1166.

Each system has its own ADAM microprocessor. The ADAM receives the information from the sample line flow elements and hot-wire anemometers and computes sample and exhaust flow rate. The sample flow rate is then adjusted based on the stack flow rate. The ADAM computer/controller adjusts the sample flow rate to be proportional to the duct flow rate. Stack flow rate and sample flow rate data is transmitted to the DCS for alarm activation and data archiving.

The beta/gamma radioactivity levels are measured and displayed on a count rate meter. WARN, HIGH, FAIL, RANGE, and RATE alarms are activated when the respective set-points are reached. Beta/gamma activity data is collected and transmitted to the DCS for alarm activation and data archiving.

<u>Stack Air Monitoring Flow-Paths</u>

The Tank Farm stack emission samples are pulled from the stack through the filter chambers with sampling blowers, and exhausted back into the stack. The active and passive samples are drawn through separate sample lines, and the flow for each line is individually controlled by its own flow control valve. The sample lines combine and this single line is connected to two vacuum blowers connected in parallel. Normally only one of the blowers will be in operation. Sample points for tritium monitoring are located immediately after the active and passive chambers. The tritium samples are withdrawn by a separate sample pump arrangement, and then exhausted back into the common exhaust line leading back to the exhaust stack.

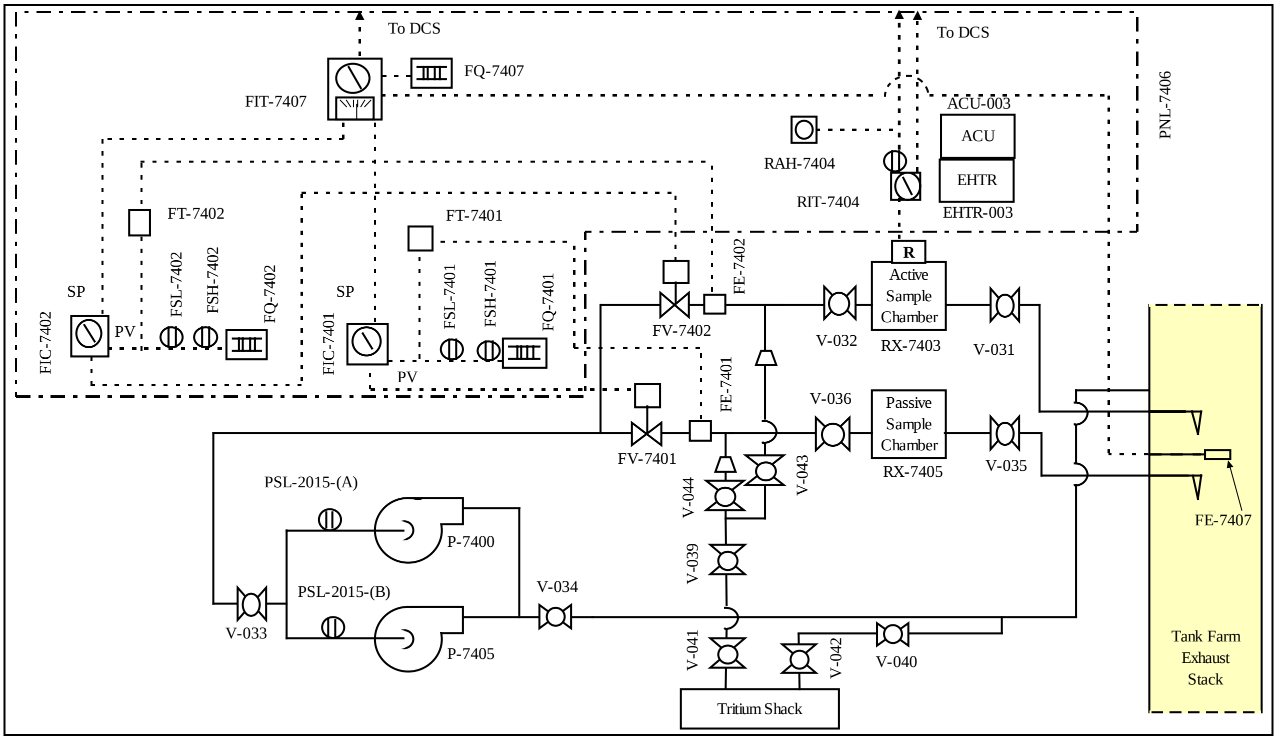

Figure 2 Tank Farm Exhaust Sample Flow Path

The HVAC air samples are taken from the main duct between the Main Exhaust fan and the main stack. The samples pass through the sample chambers, vacuum blowers, and exhausted back into the main duct. The active and passive samples are drawn through separate sample lines, and the flow for each line is individually controlled by its own flow control valve. The sample lines combine and this single line is connected to two vacuum blowers connected in parallel. Normally only one of the blowers will be in operation. Sample points for tritium monitoring are located immediately after the active and passive chambers. The tritium samples are withdrawn by a separate sample pump arrangement, and then exhausted back into the common exhaust line leading back to the exhaust stack.

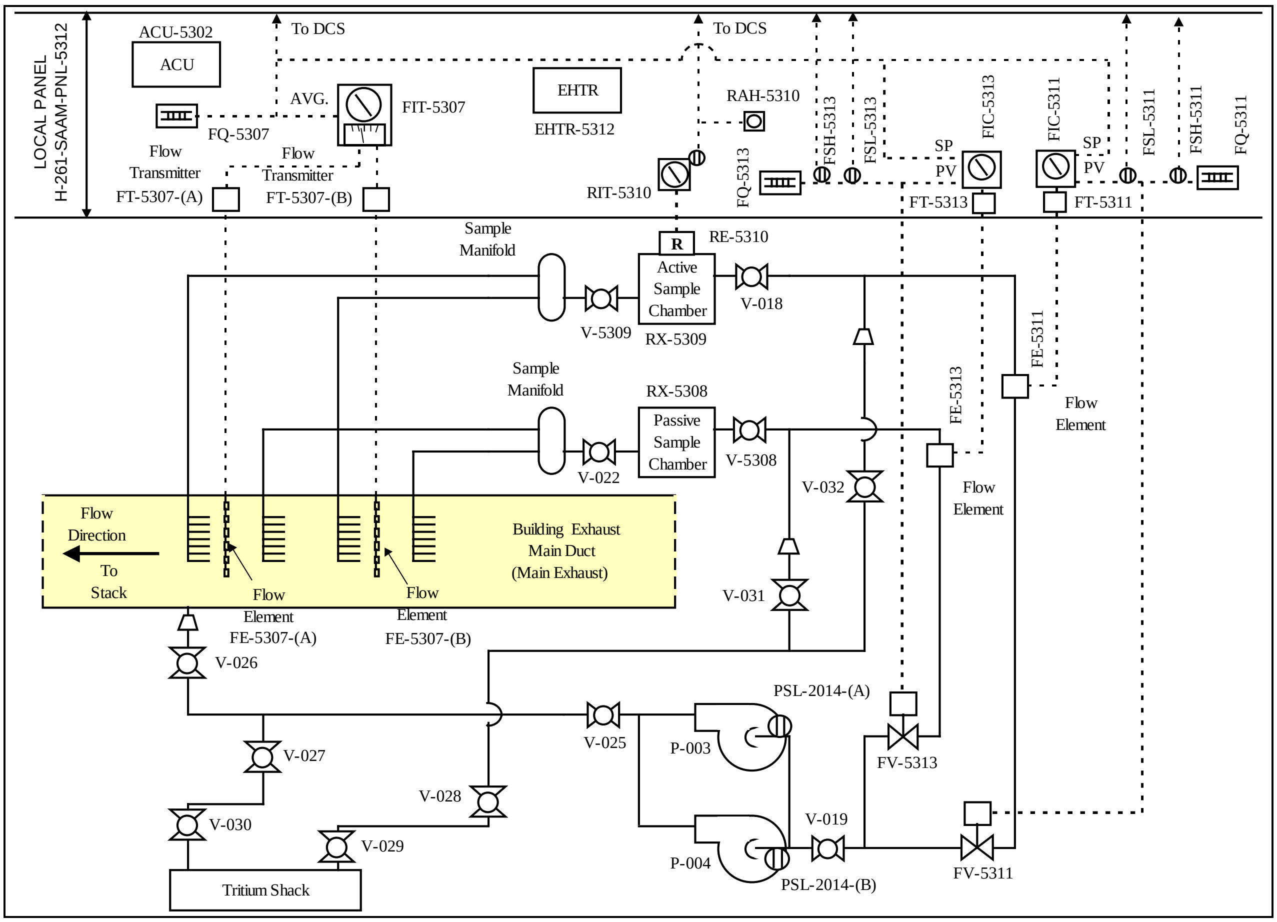

Figure 3 Building Exhaust Sample Flow Path

The Process Offgas air samples are taken from the exhaust duct between the Induced Draft fans and the CIF Stack. The samples are passed through an air ejector, the filter chambers, and exhausted back into the duct. The motive force to draw the samples from the duct is provided by an eductor. The flow rate is controlled by regulating the air flow to the eductor inlet, which in turn regulates the amount of air drawn into the eductor suction. This arrangement was designed to limit the amount of Offgas air which would pass through components. The concern was that salts in the Offgas could deposit in the flow control valves and limit their operability. Sample points for tritium monitoring are located immediately after the active and passive chambers. The tritium samples are withdrawn by a separate sample pump arrangement, and then exhausted back into the common exhaust line leading back to the exhaust stack.

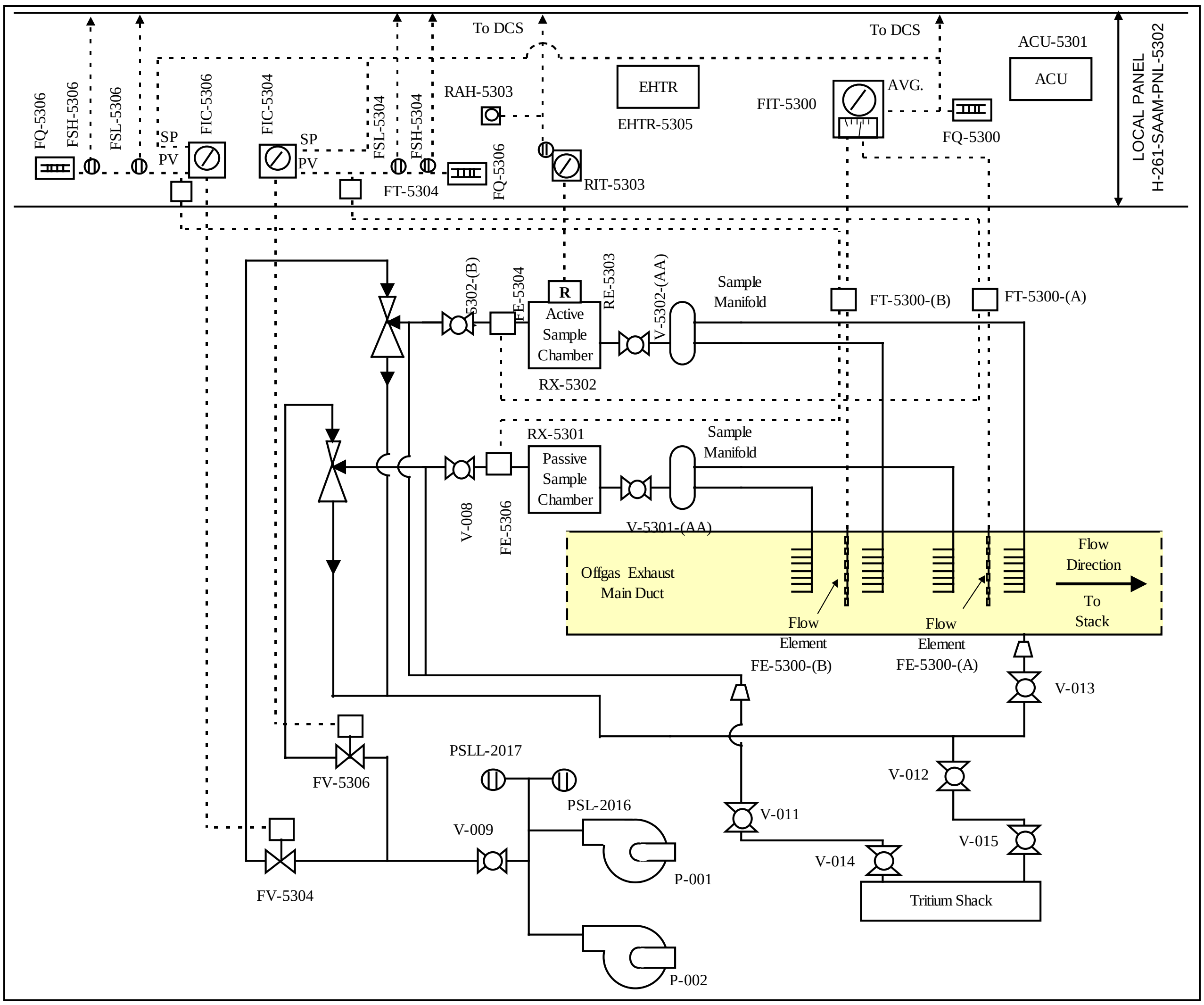

Figure 4 Offgas Exhaust Sample Flow Path

Tritium Oxide Samples

Sample points for tritium monitoring are located immediately after the active and passive chambers in each system. These samples are routed to a "Tritium Shack" where they are collected in molecular traps which are analyzed by SRTC.. The tritium samples are withdrawn by a separate sample pump arrangement, and then exhausted back into the common exhaust line leading back to the exhaust of each system. The sample system has an electric flow control valve which is controlled to maintain a flow rate through the sample line of 1.04 Liters per minute.

The tritium sample system will normally be running. During shut down, the sample lines leading to the tritium shack will remain open, and only the inlet to the filter chambers will be closed. This will allow the tritium sample pumps to continue to draw air from the exhaust lines leading to the respective exhaust ducts. If flow will be isolated to the Tritium Shack, SRTC should be contacted at 5-1166 to secure the sample system prior to securing the flow to the system. The flow control system has automatic features which will shut down the pump if no flow path is available, but should not be relied upon if the flow isolation is planned for properly. If problems occur with the tritium monitoring portion of a system flow path, SRTC should be contacted at 5-1166.

MAJOR COMPONENTS

ELO 3.1	**DESCRIBE the following major components of the Stack Air Activity Monitoring System including their functions, principles of operation, and basic construction:** **a. Isokinetic Controller** **b. Filter Chambers** **c. Flow Detector** **d. Sample Blowers/Compressors** **e. Victoreen Count Rate Meter**

Each of the three systems, Tank Farm, HVAC, and Offgas, consists of an Isokinetic Controller, sample blowers or compressors, filter chambers, flow detectors, count rate meter, and tritium sampling stations. (See Table 1, *System Component CLIs*.).

Component	HVAC	Offgas	Tank Farm
Isokinetic Controller	H-261-SAAM-PNL-5312	H-262-SAAM-PNL-5305	H-262-SAAM-PNL-7406
Filter Chamber Enclosure	H-261-SAAM-PNL-5315	H-261-SAAM-PNL-5314	H-262-SAAM-PNL-7400
Compressor/Vacuum Blower	H-261-SAAM-P-003 H-261-SAAM-P-004	H-261-SAAM-P-001 H-261-SAAM-P-002	H-262-SAAM-P-7400 H-262-SAAM-P-7405
Duct/exhaust Flow Elements	H-261-SAAM-FE-5307-(A) H-261-SAAM-FE-5307-(B)	H-261-SAAM-FE-5300-(A) H-261-SAAM-FE-5300-(B)	H-262-SAAM-FE-7407
Sample Line Flow Elements	H-261-SAAM-FE-5311 H-261-SAAM-FE-5313	H-261-SAAM-FE-5304 H-261-SAAM-FE-5306	H-262-SAAM-FE-7401 H-262-SAAM-FE-7402
Count Rate Meters	H-261-SAAM-RIT-5310	H-261-SAAM-RIT-5303	H-262-SAAM-RIT-7404

Table 1 System Component CLIs

Isokinetic Controller

Isokinetic Controller enclosures contain an ADAM microprocessor, a Victoreen count rate meter, power supply, and a DATEL printer. These components calculate, analyze and display flow and radioactivity information. The enclosures are also equipped with air conditioning units and electric heaters for climate control within the enclosure.

The ADAM microprocessor computes exhaust velocity, displays the current flow rate and transmits the data to the Distributed Control System (DCS). The main functions of the microprocessor are to calculate exhaust flow velocity, total flow, and control sample flow rate based upon the current flow velocity value. The microprocessor adjusts sample flow rate by controlling the sample flow control valves.

The keypad (Figure 8) is used to perform various functions such as starting programs, adjusts sample flow rates, displaying time and date, page up/down, etc., and to enter text. (NOTE: The programming features will have security codes applied to limit access to these functions.) The major function of the keypad is to display the meter data by pressing the "D" key.

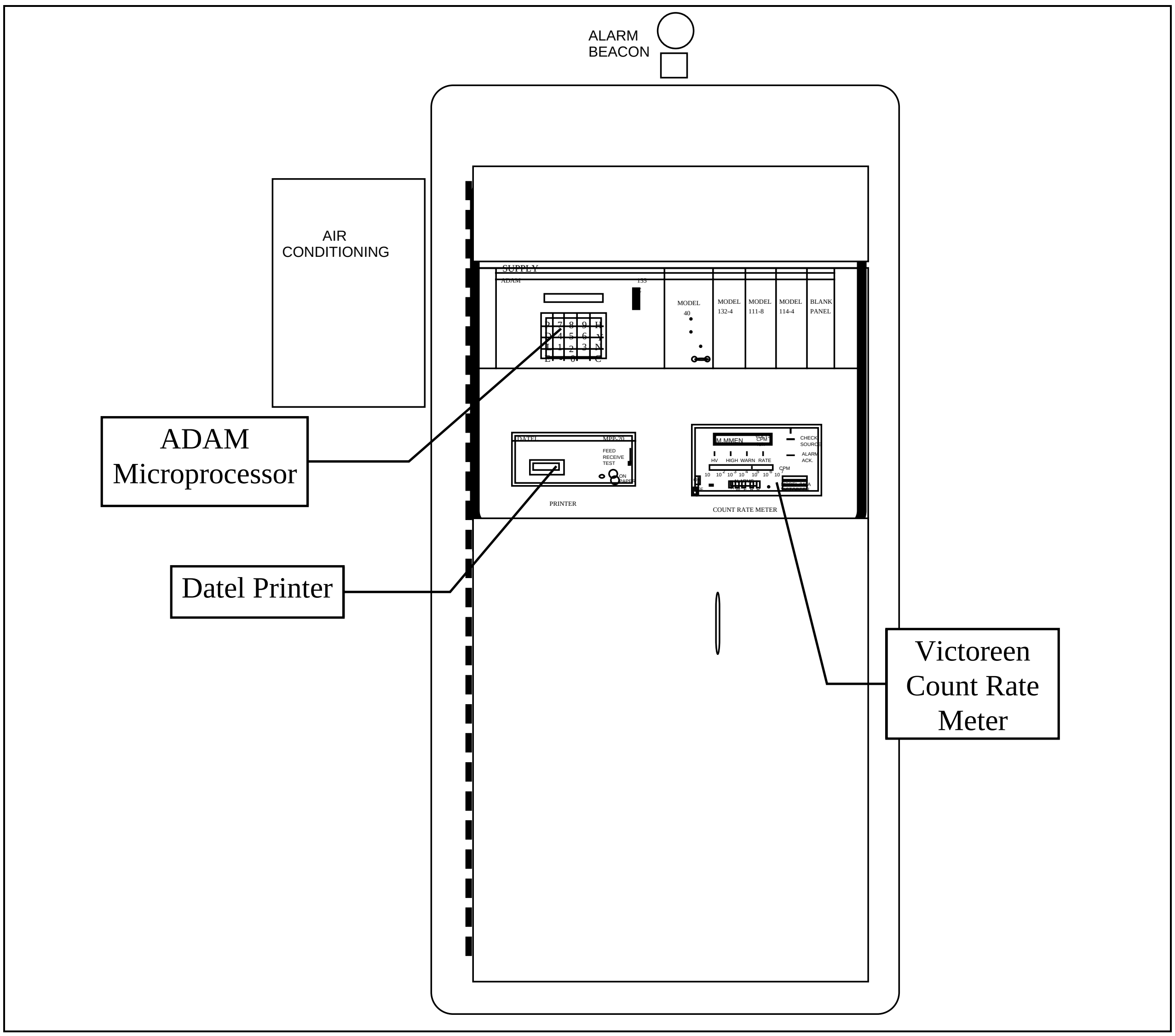

Figure 5 Isokinetic Controller Enclosure

A Datel printer is used to print hard copy of required data generated by the Kurz isokinetic monitoring system.

Filter Chambers

The Filter Chamber Enclosures contain two filter chambers (Figure 6). These enclosures are located near the Isokinetic Controller Enclosures. The active filter chamber continuously analyzes the particulate collected on the filter paper for beta/gamma radiation levels. The passive chamber collects particulate on a filter which is changed at least every seven days. The filter is then sent for laboratory analysis.

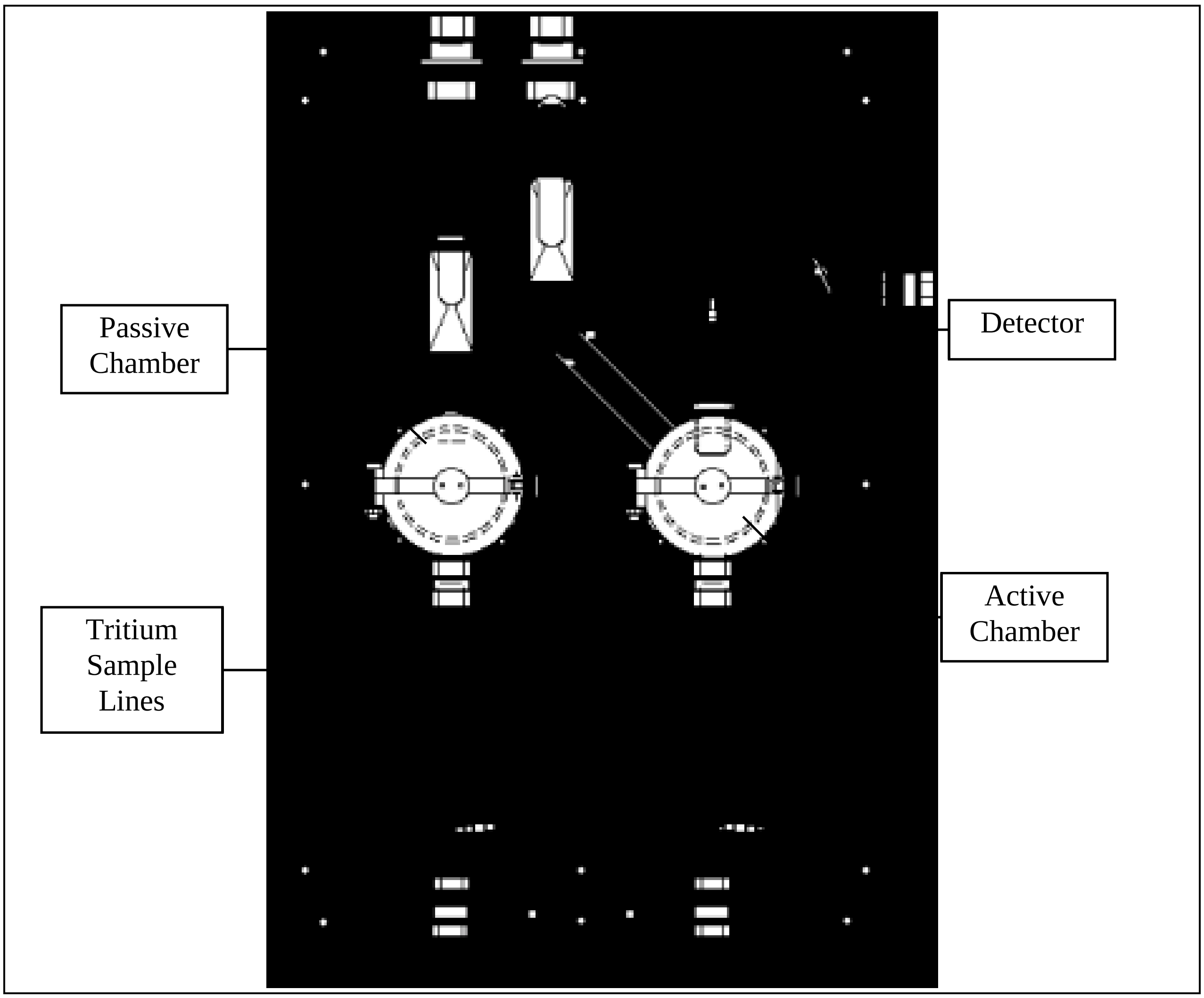

Figure 6 Filter Chambers

Flow Detector

The flow element used in the SAAM System for measuring duct flow is a hot-wire anemometer. A hot-wire anemometer consists of an electrically heated, fine platinum wire which is placed in the flow stream. As gas flows across the wire, it removes heat from the wire. As the flow increases, the heat removal increases. The cooling effect on the wire is measured as the amount of current required to maintain a constant differential temperature between the ambient RTD and the heated RTD. Hot-wire anemometers are used in the SAAM System due to their accuracy for large variations in flow rate, particularly in the low flow rate range. One disadvantage of the hot-wire anemometer is that large fluctuations in steam or water vapor content significantly changes the heat removal capability of a gas stream. To compensate for this effect of water content, correction factors are programmed into the ADAM controller by Maintenance, but the water content must remain relatively stable to maintain the accuracy of the programmed constant.

The flow detector is combined with the sample piping to form a common unit for measuring and sampling flow. The unit shown in Figure 6, *Hot-Wire Anemometer,* is from the Offgas duct. It consists of twelve sample points on the piping which surround the hot-wire anemometer in the center.

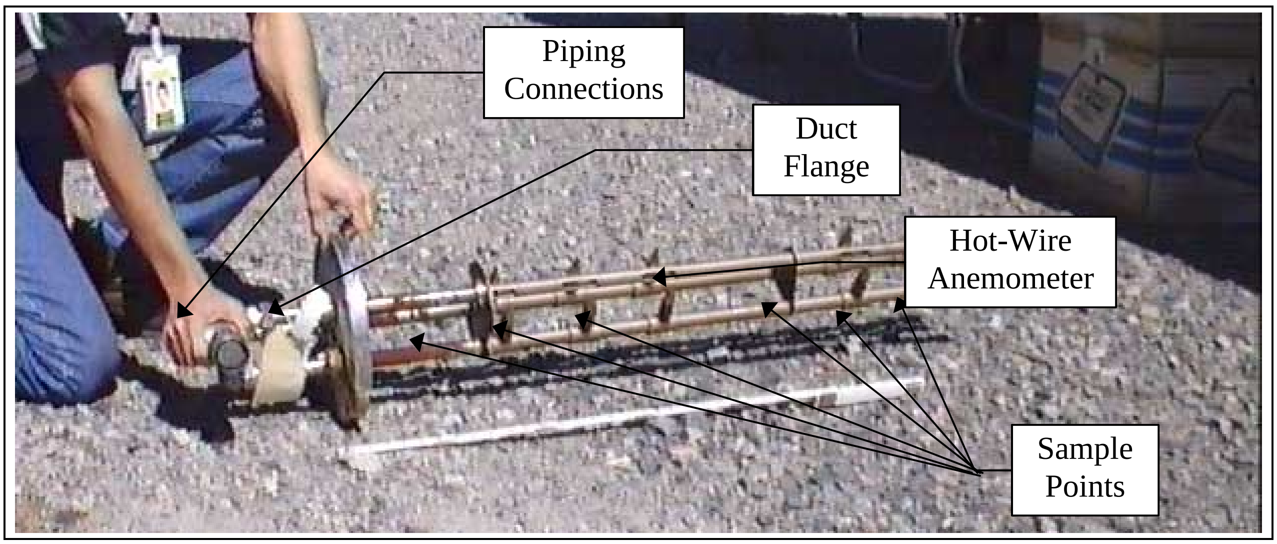

Figure 7 Hot-Wire Anemometer

Sample Blowers/Compressors

The Tank Farm and the Building Main Exhaust vacuum blowers are manufactured by Roots. The Offgas system compressors are manufactured by Thomas. Air samples are pulled from the Tank Farm stack or respective duct and are processed through the filter chambers and exhausted back into the stack or duct. The control switches for the vacuum blowers are located in the respective areas near the Isokinetic Controller enclosure. The Offgas compressors do not have control switches, and are either energized by their respective disconnects and pressure switches, or are not energized.

Victoreen Count Rate Meter

The count rate meter, manufactured by Victoreen, displays the counts-per-minute from the active filter chamber, indicates the respective alarms with red lamps, and provides an Alarm Acknowledge push-button. The Victoreen data can only be archived via DCS.

Tritium Sampling Station

There are two CIF tritium sampling shacks, one for the HVAC and Offgas located south of the HVAC HEPA filter area, and one for the Tank Farm located on the northwest corner of the Tank Farm. These sampling stations tap the sample blower discharge and utilize a molecular trap to sample the effluent. The samples are analyzed in the laboratory for tritium oxide levels. Each sample line entering the shack has a trap associated with it. In addition to the individual traps, each sample line also has sample pumps and flow controls to maintain consistent sample rates to the sample chamber.

INSTRUMENTATION

ELO 3.3	**DESCRIBE the following Stack Air Activity Monitoring System instrumentation including indicator location (local or Control Room), sensing points, and associated instrument controls:** **a. Flow Detectors** **b. Count Rate Meters**

The stack monitoring systems primarily consist of high/low flow alarms, radiation alarms, flow indicators, and flow totalizers. Status indicators for the Victoreen are located on the local panels, and the information from the ADAM microprocessor is available through the digital display. The information from each is transmitted to the DCS.

Flow Detectors

There are three main detection points for each exhaust system. The SAAM System measures duct flow rate, active sample flow rate, and passive sample flow rate. The location of detector sample points is illustrated in Figures 2 through 4. Flow indication is available through the digital display located on the ADAM, and it provides exhaust duct flow and active and passive sample line flow data. The data is available to operators by scrolling through the display screens of the ADAM. Each of the three locations is monitored by an individual system. The flow rates are also available for display at the DCS and can be archived. The DATEL printer can also be used to print the information for records or logs. Additionally, Offgas flow is also received and recorded by a strip chart recorder located on the Rad Monitoring Panel in the Control Room.

Flow Display

Initially, the display will be in the "Executive State." From this mode, the operator can proceed to "Display", "Program", "Help", or "Log" modes. The "Log" mode is used to transfer data from the ADAM to a peripheral device such as a laptop or other computer, and will not be used by operator. The "Program" mode should only be used by operators to reset the totaled flow after the value has been recorded. The "Display" mode will be the option used most by the operator. When in any mode, repeatedly pressing the "Clear" (C") key will return the ADAM to the executive state. The repeated use of the "C" key can be thought of as a fail-safe escape.

Flow Totalizers

The ADAM system computes the total stack flow in standard cubic feet (SCF). The total stack flow is a computation of average flow summed over an elapsed time. This system can display and print this information on request. The data is available to operators by scrolling through the display screens of the ADAM. Each of the three locations is monitored by an individual system. The total flow is not available for display at the DCS and can only be archived by the ADAM. This data can be lost if the operator enters the program mode and resets the totalizers.

High/Low Flow Alarms

High/Low flow alarm switches are located both at the local panels and at the DCS. These alarms monitor stack flow and sample flow. The instrument sensing locations are in the Offgas, HVAC, and Tank Farm active and passive sample lines, and in the exhaust duct. The high and low set-points are listed in Table 2, *Alarm Setpoints*, which is included in the Controls, Interlocks, and Alarm chapter. The sample line flow alarms are switches driven by internal programming in the ADAM which have external connections to the DCS. The high duct flow alarm is internal to the DCS. The display panel on the ADAM diplays the flow data, but no other indications are available to notify operators of the alarm locally.

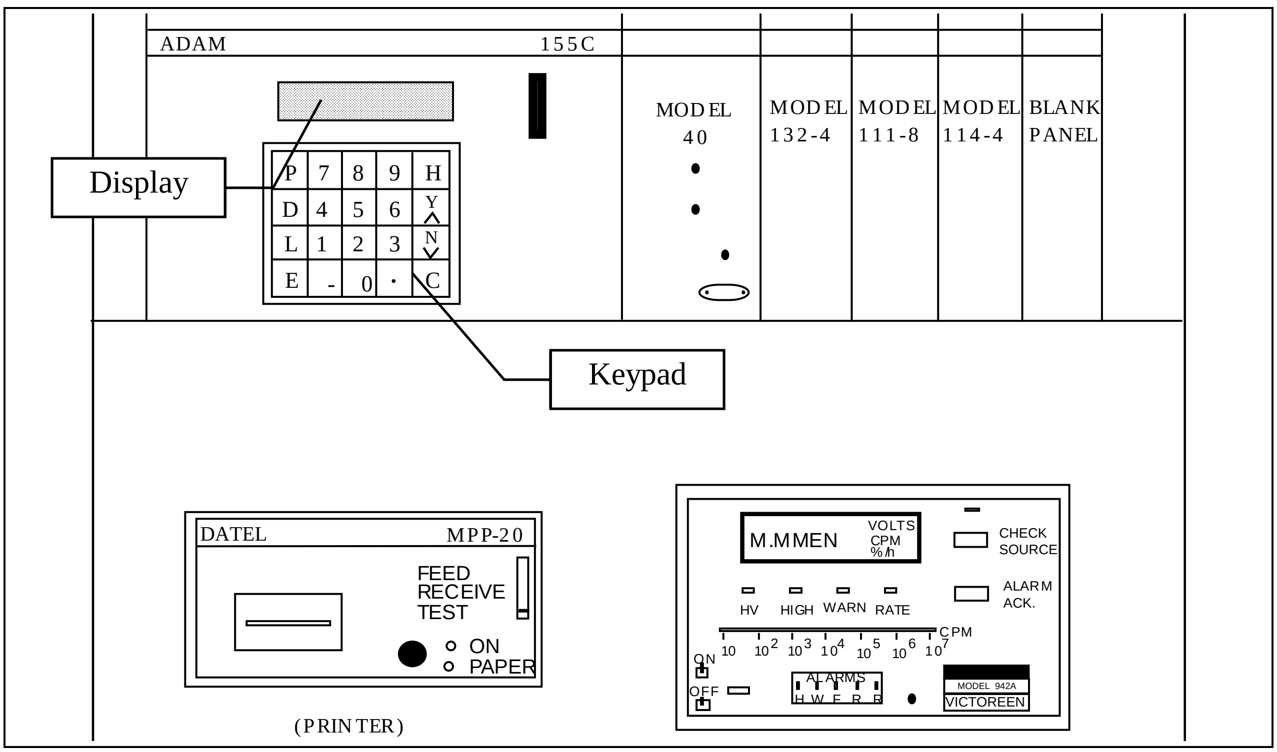

Figure 8 Display and Keypad

Count Rate Meters

The count rate meter on each of the panels is a Victoreen Model 942A. Each meter is connected to a scintillation detector located within the active sample chamber. The count rate meter provides power to the detector and receives radiation activity level signals from the detector. The counts per minute (CPM) value will be displayed as a three-digit number in scientific notation on the count rate meter. For example, $2.97X10^4$ will be displayed as 2.97E4. The bar graph will display the same value as the digital display on a logarithmic scale.

NORMAL/WARN/HIGH display lights on the Victoreen count rate meter will indicate the condition of the respective system. Under NORMAL operation the bar graph will be green. If the measured radiation field increases above the WARN alarm limit the bar graph will change to amber. If the measured radiation field exceeds the HIGH alarm limit, the bar graph will change to red. In each respective case, green, amber, or red, the indicator lights will change to the same color as the bar graph.

Radiation Alarms

Radiation alarms are located on the meter, on the local panel, and at the DCS. The sample locations are the Offgas, HVAC, and Tank Farm active radioactivity monitors. Each high radiation condition sounds an alarm at its respective local panel but the warning, rate, and range indication are only displayed on the meter itself..

The High Voltage (HV), HIGH, WARN, AND RATE push-buttons will display the respective current setting when depressed.

The ALARM ACK push-button will release the alarm relays and flash indicators when depressed after the alarm condition has been corrected. When this push-button is depressed while a flashing alarm condition exists, the indicators will go to a steady state.

If the measured radiation field falls below the minimum range, the panel display will read 0.00E0 CPM, the bar graph will extinguish, and the RANGE alarm will illuminate red. If no counts are received for five minutes, or if the detector is exposed to a radiation field exceeding two decades above the detector operating range, the FAIL alarm will be illuminated. This is different from the monitor fail alarms associated with the Air Monitoring System and Area Radiation Monitoring System.

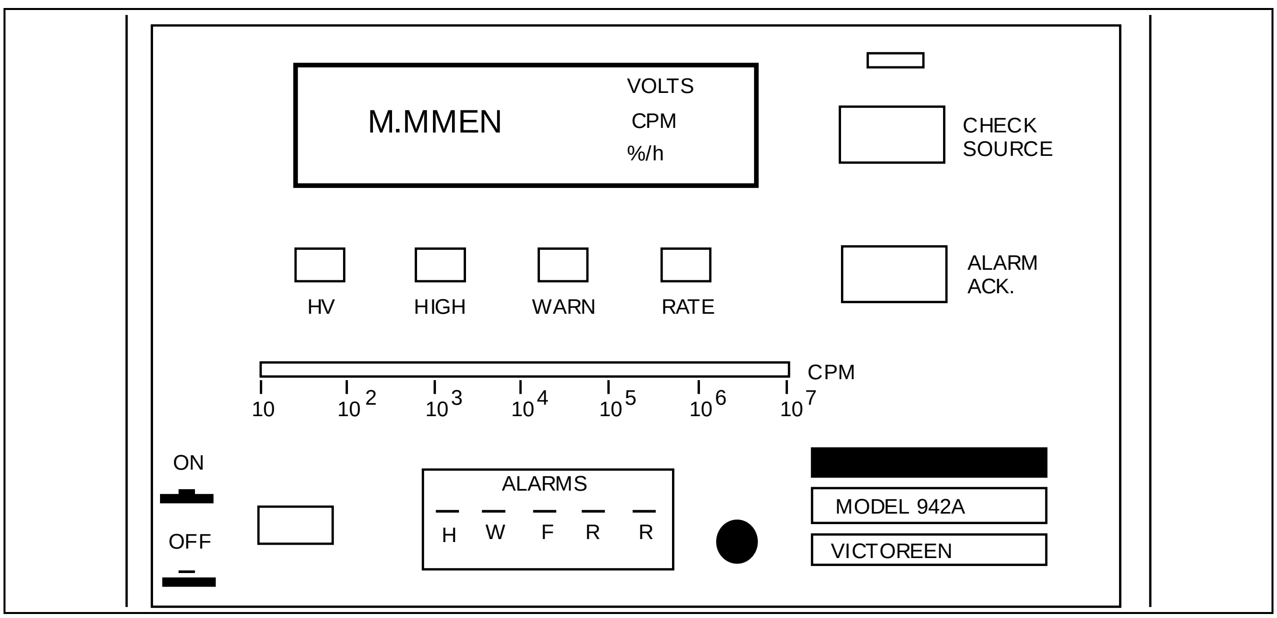

Figure 9 Victoreen Count Rate Meter

CONTROLS, INTERLOCKS AND ALARMS

ELO 3.4	**EXPLAIN how the following Stack Air Activity Monitoring System equipment is controlled in all operating modes or conditions to include control locations (local or Control Room), basic operating principles of control devices, and the effects of each control on the component operation:** **a. Compressor** **b. Sample Blowers** **c. Flow Control Valves**

Controls

The respective rate meter power supply, printer, and blower controls are located at the three Isokinetic Controller Enclosures. The controls for starting the vacuum blowers are part of the Isokinetic Controller Unit, and are found on the panel of the Tank Farm and Building Exhaust SAAM controllers. The controller for the Offgas compressors are hard wired to start when the compressor power supply is closed.

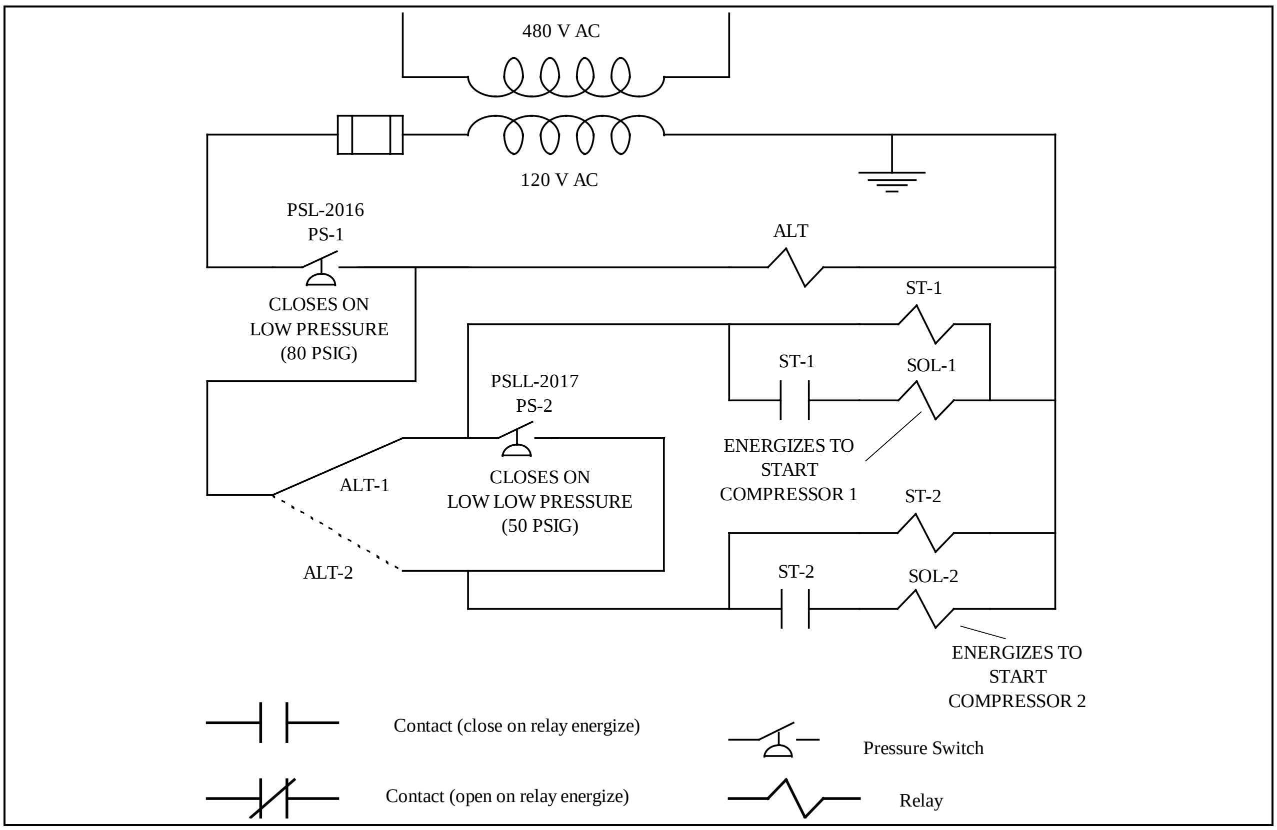

Figure 10 Offgas SAAM Compressor Control Circuitry

Offgas Compressors

The Offgas compressors operate on demand. When the low pressure switch (H-261-SAAM-PSL-2016) senses 80 psig, the compressor selected as the primary will start and run until the pressure switch is reset. If the low low pressure switch (H-261-SAAM-PSL-2017) senses pressure less than 50 psig, the alternate compressor will start to assist the first compressor in maintaining discharge pressure until the low low switch is reset. The primary and alternate compressors are determined by the position of an electrical contact in either the ALT-1 or ALT-2 position. See Figure 10, *Offgas SAAM Compressor Control Circuitry*, for details.

Tank Farm an Building Exhaust Vacuum Blowers

The Tank Farm an Building Exhaust Vacuum Blowers have three position control switches for each of their motors. The circuitry is designed to start a blower on low vacuum (or high pressure) sensed at the inlet of the blower. The setpoint for these switches is 0.9 inwc vacuum. One disadvantage of the control for these blowers is that once a blower starts on low vacuum, it will remain energized. This occurs because the pressure switch and the main line coil contact are in parallel. Once the main line coil energizes, the blower will run, and the contact in parallel will remain closed regardless of the condition of the other blower or the pressure switch.

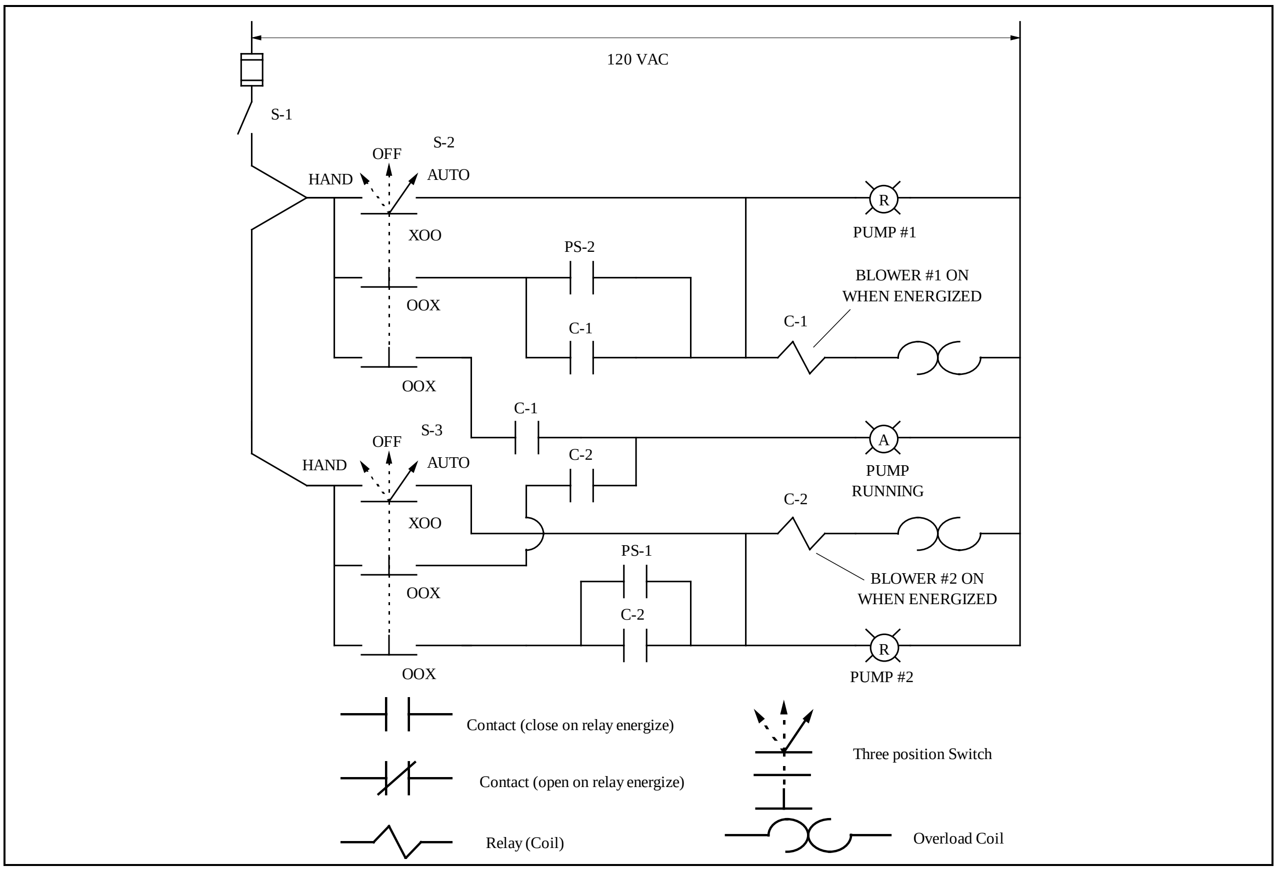

Figure 11 Vacuum Blower Motor Control Circuitry

Flow Control Valves

The flow control valves open or close in response to a correction signal developed by the ADAM microprocessor. The correction signal is a +15 or -15 VDC signal. If the measured sample flow rate is too high as compared to the measured duct flow rate, the valve will be sent a signal to close in order to decrease the sample flow rate. If the measured sample flow rate is too low as compared to the measured duct flow rate, the valve will be sent a signal to open in order to increase the sample flow rate. The signal will be applied to the valve for a period of time to throttle the flow to the amount required.

The standard time to operate the valve from full open to full closed is thirty (30) seconds. This time can be reduced by lowering the gear ratio inside the valve, but at the sacrifice of accuracy. Because the valve only responds to error correction signals, the valve will be idle for most periods. The valve position will remain the same for changes in pressure, during periods of constant flow, or in the event of power loss to the valve.

ELO 3.5	**DESCRIBE the High Offgas Flow interlock to include the interlock actuating condition, effects of interlock actuation, and the reason the interlock is necessary.**

<u>Interlocks</u>

In addition to the high flow alarm, the high Offgas exhaust flow rate detected by the Stack Air Activity Monitoring System is used to meet RCRA permit requirements, and interlocks to shut down Waste Feed when Offgas flow is too high. This interlock is based upon the requirement for gases to remain at least two (2) seconds in the Secondary Combustion Chamber (SCC). If the Offgas exhaust flow rate is too high, the gases will be passing through the SCC at a rate which will remove them from the SCC before the two second residence time has been met.

ELO 3.6	**INTERPRET the following Stack Air Activity Monitoring System alarms, including the conditions causing alarm actuation and the basis for the alarms:** **a. High Radiation** **b. Flow Alarms** **c. Monitor Fail Alarms**

Alarms

System WARN, HIGH, FAIL, RANGE, and RATE radiation limits are set by Radiological Control personnel and can be checked on the Victoreen by pressing the respective button. The WARN and RATE signals work together such that either on can produce its own alarm, or if both are rising concurrently but below their individual setpoints they will also cause an alarm. The LOW/HIGH flow limits for sample lines are set by programming the ADAM Microprocessor, and the duct flow alarms are internal to the DCS.

Location	Alarm	Setpoint (*Note 1)
Offgas	High Exhaust Duct Flow	16644 SCFM
	Low Exhaust Duct Flow	7500 SCFM
	High Active Sample Line Flow	2.67 SCFM
	Low Active Sample Line Flow	0.95 SCFM
	High Passive Sample Line Flow	2.67 SCFM
	Low Passive Sample Line Flow	0.95 SCFM
	High Radiation	2400-2700 CPM
Main Exhaust	High Exhaust Duct Flow	22500 SCFM
	Low Exhaust Duct Flow	15000 SCFM
	High Active Sample Line Flow	3.65 SCFM
	Low Active Sample Line Flow	2.75 SCFM
	High Passive Sample Line Flow	3.65 SCFM
	Low Passive Sample Line Flow	2.75 SCFM
	High Radiation	2400-2700 CPM
Tank Farm Exhaust	High Exhaust Duct Flow	25 SCFM
	Low Exhaust Duct Flow	10 SCFM
	High Active Sample Line Flow	1.25 SCFM
	Low Active Sample Line Flow	0.5 SCFM
	High Passive Sample Line Flow	1.25 SCFM
	Low Passive Sample Line Flow	0.5 SCFM
	High Radiation	2400-2700 CPM

Table 2 Alarm Setpoints *

* Note 1 : Values are from the Setpoint Document dated 3/08/96. These values are subject to change

High Radiation

The high radiation alarm generated by the Victoreen is the only radiation alarm sent to the DCS. The WARN and RATE alarms are available at the Victoreen only. The high radiation alarm setpoint will be between 2400 and 2700 CPM based upon the source strength of the known source used when source checking the detector. The high radiation alarm may be caused by the accumulation of contaminated particulates on the filter paper, or the detector may also alarm due to a rise in background radiation. In the event of a high radiation alarm, RCO personnel will respond by evaluating conditions at the sample chamber.

Flow Alarms

The low and high flow alarms for the sample line are sensed by the flow element in the sample line and generated by the ADAM microprocessor. These signals could be due to flow conditions caused by line clogging, valve mispositioning, restrictions, or improper operation of the flow control valves. The signal could also be generated by a failure in the flow element or ADAM microprocessor.

Monitor Fail Alarms

If the measured radiation field falls below the minimum range (the default setting is 10 CPM), the panel display will read 0.00E0 CPM, the bar graph will extinguish, and the RANGE alarm will illuminate red.

Two conditions will cause a FAIL alarm. If no counts are received for five minutes, or if the detector is exposed to a radiation field exceeding two decades above the detector operating range. This is different from the monitor fail alarms associated with the Air Monitoring System and Area Radiation Monitoring System.

SYSTEM INTERRELATIONS

Distributed Control System

The Stack Air Activity Monitoring System interfaces with the Distributed Control System (DCS) through the Stack Air Activity Monitoring local panels. Alarm signals received in the local panels activate PLC relays. The PLC relays are used to signal Point Tag Displays in the DCS. The DCS receives the following alarms and indications in this manner::

- The DCS receives signals from the ADAM microprocessors for high and low flow through the exhaust ducts.
- The DCS receives signals from the Victoreen count rate meters for high beta/gamma radiation and monitor failure.
- The DCS receives signals from the low flow switches indicating low flow through a sample line.
- The DCS receives signals from high flow switches for high flow through a sample line.

Air Monitoring System

The Air Monitoring (AM) System interfaces with the Stack Air Activity Monitoring System at the Tank Farm exhaust stack. Since flow due to waste tank exhaust venting through the Tank Farm exhaust stack is not constant, the SAAM System relies upon the AM System for constant flow.

The SAAM System draws a proportional sample of the air from the Tank Farm exhaust stack. Since the sample is proportional to the flow rate through the stack, if there is no flow through the stack, the control valves close completely and the SAAM System vacuum blowers would overheat and become damaged due to no flow. The output from the AM System into the Tank Farm exhaust stack ensures a minimum flow through the exhaust stack, and therefore, a minimum flow through the SAAM System vacuum blowers.

Offgas System

The Stack Air Activity Monitoring System interfaces with the Offgas System at the Offgas System duct after the HEPA filters. The Stack Air Activity Monitoring System monitors the Offgas exhaust for activity and flow rate. Alarms are provided for high activity levels, high flow rate and low flow rate. In addition to the high flow alarm, the high Offgas exhaust flow rate detected by the Stack Air Activity Monitoring System is used to meet RCRA permit requirements, and interlocks to shut down Waste Feed when Offgas flow is too high. The SAAM System for the Offgas exhaust duct must be in operation for all periods of flow though the Offgas system.

Heating, Ventilation, and Air Conditioning System

The Stack Air Activity Monitoring System interfaces with the Heating, Ventilation and Air Conditioning System (HVAC) at the Main Exhaust System duct after the HEPA filters. The Stack Air Activity Monitoring System monitors the Main Exhaust System for activity and flow rate. Alarms are provided for high activity levels, high flow rate and low flow rate. The SAAM System for the building exhaust duct must be in operation when conducting operations which could lead to airborne particulate activity. These operations include, but are not limited to incinerator operations, ashcrete operations, and maintenance or repairs which opens or exposes potentially contaminated system boundaries..

Tank Farm Exhaust System

The Stack Air Activity Monitoring System interfaces with the Tank Farm Exhaust System after the HEPA filter and organic filter. The Stack Air Activity Monitoring System monitors the Tank Farm Exhaust System for activity and flow rate. Alarms are provided for high activity levels, high flow rate and low flow rate. The SAAM System for the Tank Farm Exhaust must be in operation when there is any contaminated materials in the Tank Farm.

Electrical Distribution

Power for vacuum blowers, isokinetic sample units, and compressors is provided by Electrical Distribution. The blowers and sample unit for the Tank Farm are powered by MCC 8. The blowers, sample units, and compressors for the HVAC and Offgas Systems are powered by MCC 7. Since the Air Monitoring System vacuum blowers for the Tank Farm are cross powered (CAM Blower #1 from MCC 7 and CAM Blower #2 from MCC 8), if the #2 Standby Diesel Generator fails to operate on a loss of power, the Tank Farm Air Monitoring System vacuum blower must be switched to #2.

Health Physics and Area Radiation Monitoring System

The SAAM System sends Offgas flow signal to the strip chart recorders located on the front right portion of the Rad Monitoring Panel. This is the only interrelation that the SAAM System has with the Health Physics and Area Radiation Monitoring System.

INTEGRATED PLANT OPERATIONS

ELO 4.2	Given applicable procedures and plant conditions, DETERMINE the actions necessary to perform the following Stack Air Activity Monitoring System operations: a. Startup b. Shutdown

Normal Operations

Normal operations consist of system alignment, system startup, and normal monitoring operations.

System Startup

The Isokinetic Control Enclosures are energized by closing the disconnect switch internal to the enclosure and placing the power-on switch to the "ON" position. The air conditioning and heater units of the enclosures are verified to be in the "ON" position.

The Tank Farm Stack Air Sample Blower switch (H-262-SAAM-HS-2015-(B)) is switched to " " and Tank Farm Stack Air Sample Blower switch (H-262-SAAM-HS-2015-(C)) is switched to "AUTO."

The HVAC Disconnect Sample Panel is verified as "CLOSED," and the Power-On Switch is positioned to the "ON" position. The HVAC Sample Blower switch (H-261-SAAM-HS-2014-(B)) is placed in the "HAND" position, and HVAC Sample Blower switch (H-261-SAAM-HS-2014-(C)) is placed in the "AUTO" position.

The Process Offgas Field Wiring Compressor Disconnect is verified to be in the "CLOSED" position, the Compressor Switch is "ON", and the power-on switch is positioned to "ON."

The sample flow rate is displayed by pressing the "D" key on the keypad of the Isokinetic Control Panel. Both flow rates, active and passive, are verified to be in accordance with 261-SOP-SAAM-01 and the Victoreen 942A push-button switch is pushed to the "ON" position. If required, alarms are cleared by pushing the Alarm Acknowledge push-button. Heat trace is provided on the sample tubing for the Offgas and Tritium Systems, and is started in accordance with its own SOP.

Normal Operation

During normal operation of the Stack Air Activity Monitoring System, required parameters of the system are observed and monitored. Effluent samples are evaluated by beta/gamma monitors and tritium levels are determined by laboratory analysis. The air flow rate is totaled over a given period, and the passive samples are analyzed with this information to develop an average activity in the exhaust. In order to access the total flow through the system, the operator will need to utilize the ADAM display and control keyboard.

The "Display" mode can be accessed from the executive state by pressing the "Display" ("D") key. The "Display" mode is used to show information from the various meters. The initial screen will indicate which meter is being accessed, and can be used to cycle through the meters by pressing the "Up(^)/Yes" key or the "Down(v)/No" key. After selecting the meter to display, repeatedly cycling the "D" key will cycle through the available information for that meter. If the meter is a temperature sensor, the information available is identification number, temperature currently sensed, and the channels averaged by that meter. If the meter is a flow meter, the information scrolls through the identification number, flow rate currently sensed,

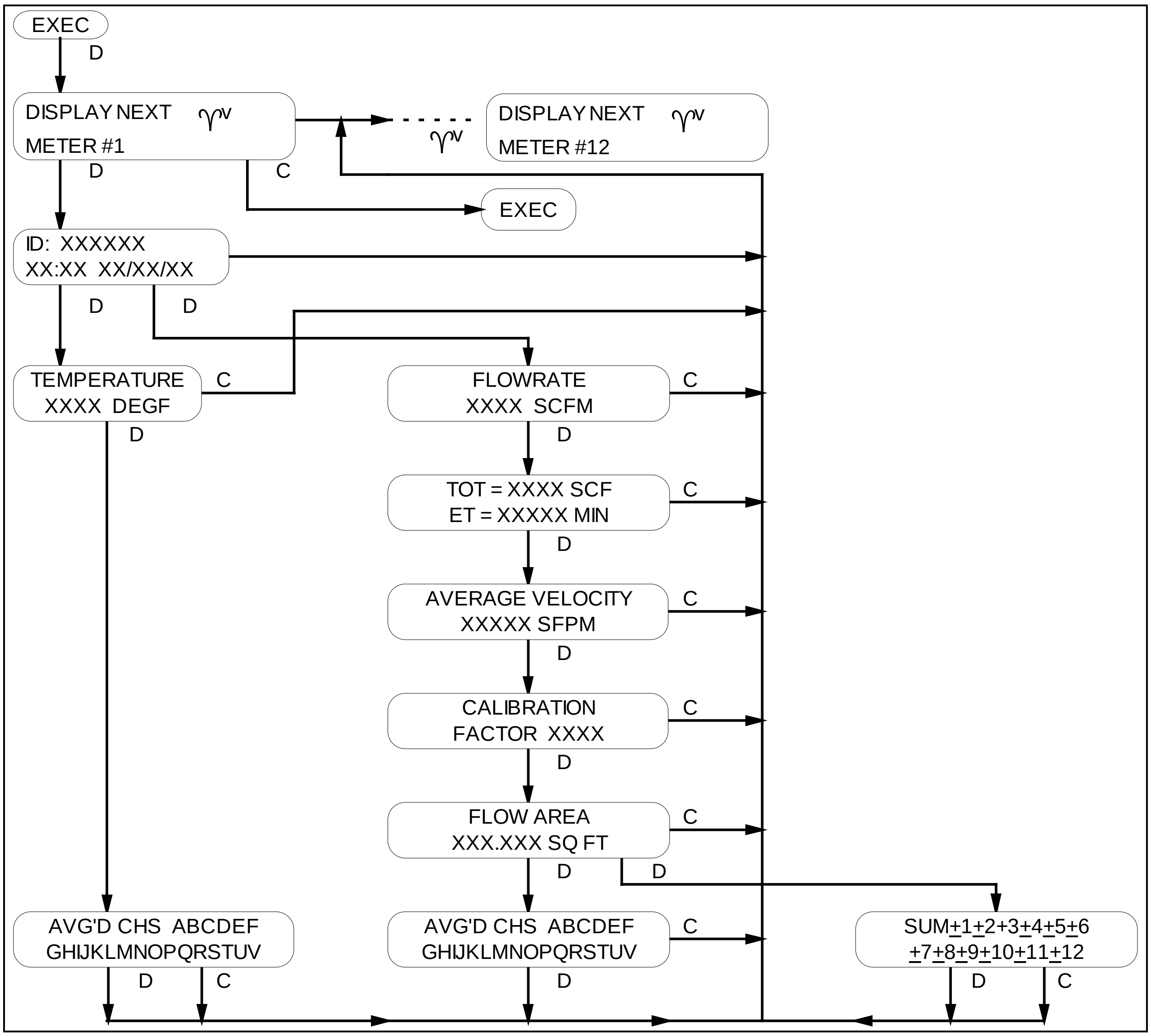

Figure 12 Display Screen Logic

totaled flow and time elapsed during the totalization, average velocity, calibration factor, flow area, and either the channels averaged by that meter or the detector used to total the flow. See Figure 12, *Display Screen Logic*, for sequence of display information.

Procedure 261-SOP-SAAM-01, Stack Air Activity Monitoring, contains check lists and sign-off sheets that require completion during start-up and operation of the system. The procedure becomes a Record when completed and shall be processed in accordance with SW-Q1-1171, Records Management.

Infrequent Operations

Infrequent Operations include shutdown of exhaust monitoring systems, filter change in the active and passive chambers, source checks of the detectors, and calibrations performed on the detectors. For all these operations, alarms are expected as system components are either tested or secured, therefore, operators should be made aware of changes in system status prior to conduct of the applicable procedure.

System Shutdown

There are various degrees of shutdown. If the complete CIF facility is in shutdown mode, the SAAM system is not required to be operating. If the Offgas, HVAC, and/or Tank Farm systems are running the appropriate SAAMs must be running.

When the Stack Air Monitors are no longer required, the monitoring systems may be secured by de-energizing the monitoring instruments and the sampling blowers.

Procedure 261-SOP-SAAM-01, Stack Air Activity Monitoring, contains check lists and sign-off sheets that require completion during shut-down of the system. The procedure becomes a Record when completed and shall be processed in accordance with SW-Q1-1171, Records Management.

Filter Paper Change

Periodically, the filter paper from the active and passive chambers will need to be surveyed and replaced. This should not involve extensive radiological controls based upon the expected levels exhausted from the facility. If high levels of activity are detected prior to or during the change out, appropriate controls will be implemented to prevent the spread of contamination.

The filter papers installed in the chambers will need to be changed based upon requirements for flow and radioactivity analysis. If a high radiation alarm is received from an active chamber monitor, the active and passive filter papers will be locally analyzed and changed out by the RCO personnel responding to the alarm. As a minimum, the filter paper will be changed when the weekly source check is performed.

Regardless of the radiological precautions required, RCO personnel will remove and replace the filter papers. The steps involved during the change of filters will require securing flow through the chamber, and the low flow alarm for the affected line will be received by the ADAM and DCS as a result.

Detector Source Check

Source checks of active detectors are required weekly to ensure proper operation. Source checks will be performed by RCO personnel and should be performed in conjunction with filter paper changes. A source check is a procedure where a known radioactive source is positioned for the detector to receive its radiation. By comparing the known source strength to the indicated readings from the detector, the operability of the detector is verified. Source checks may be performed for several strengths of sources or even different orientations or distances for the same source.

Loop Verification and Calibration

These procedures will be performed by Maintenance, but will affect operation of the detector and potentially cause alarms.

Standard calibrations of all the flow detectors have a periodicity of semi-annually to meet the requirements of the air quality permit. Because the Offgas SAAM detector is used to ensure the two second residence time in the SCC, the Offgas flow detector must also be calibrated monthly in accordance with vendor specifications. Each calibration may be required to be performed upon failure of an instrument to properly indicate or alarm. The semi-annual calibration requires taking fourteen (14) flow measurements over a period of time and comparing the detector output with known values. The monthly calibration of the Offgas detector applies a known signal into the flow instrumentation and verifies output signals are what should be expected.

The count rate meters will be calibrated at least annually. The procedure tests and calibrates the alarm functions, indications, and control functions of the Victoreen, and also tests the isokinetic controller for proper operation. Operators should be made aware of alarms being tested prior to commencing the procedure.

ELO 3.2 Given values for key performance indicators, DETERMINE if Stack Air Activity Monitoring System components are functioning as expected.

Abnormal Operations

If routine surveillance and/or testing reveals defective or inoperable equipment, Maintenance should be notified immediately. Alarming conditions are not expected unless testing of their operability is in progress. All alarms must be investigated, and some alarms require that operations be shut down until the cause has been found and corrective action taken. High radiation alarms must also be logged as part of regulatory commitments.

Warning Alarm

A WARN alarm (amber flashing indicator on the count rate meter) indicates that the measured level of radiation has increased above the WARN alarm set-point. The cause of this condition should be determined, and corrective action taken. A warning alarm will only be seen at the Victoreen, so the Field Operator will be required to report its occurrence to the Control Room.

High Radiation Alarm

When a HIGH radiation alarm occurs, (red flashing indicator), an abnormal stack release is indicated. Supervision will be notified as to the area conditions and restrictions. Upon receipt of a high radiation, operators will be dispatched to investigate the cause. Action shall be taken as necessary to correct the high radiation condition, and the alarm, cause and corrective action need to be logged to meet permit requirements. Permits also require that waste feed or tank filling be secured and not restarted until the cause is found and corrected.

RCO personnel will respond to a high radiation by monitoring for high area radiation using portable detectors. Once the radiation level is determined, RCO will locally check both the active and the passive filter papers for particulate contamination. If the alarm was caused by a high radiation level, efforts should be made to determine the source of the radiation. If the alarm was caused by particulate contamination, the HEPA filters will need to be inspected for evidence of improper operation. If neither condition is indicated, the detector will need to be source checked to verify proper operation and alarm settings.

Failure Alarm

The FAIL alarm (red indicator) will occur if no counts are received from the detector for five minutes, and/or the detector is exposed to a radiation field approximately two decades above the operating range. If the second scenario occurs, a fuse on the main circuit board of the Victoreen will blow, and Maintenance will be required to replace the fuse and possibly recalibrate the meter. The response to a high exposure field is done to alert operators of the extreme high radiation condition.

Range Alarm

The RANGE alarm (red indicator) will occur when the measured radiation field is either below minimum range or above the over-range set-point. The panel display will indicate 0.00E0 CPM if the alarm is caused by the low measurement and will indicate EEEEE CPM if the alarm is caused by an over-range measurement. Over-range measurements are reported to Supervision and Radiological Control personnel for assessment. If the meter indicates an over-range condition, then the high radiation alarm should also be indicated, and the action taken for high radiation. An under-range condition is also a meter failure condition, and the actions for monitor failure must be taken.

Rate Alarm

The RATE alarm (red indicator) will occur when the measured radiation field exceeds the rate-of-rise limit. The rate-of-rise limit is expressed as a percentage change per hour. The cause of this condition should be determined, and corrective action taken.

In each condition of normal operation, WARN, HIGH, FAIL, RANGE, or RATE, the bar-graph will indicate the condition by changing color. Normal condition is indicated by a green bar-graph, WARN alarm is indicated by an amber bar-graph, RANGE alarm is indicated when the bar-graph is extinguished, and the other alarm conditions are indicated by a red bar-graph.

High and Low Flow Rates

The air flow rates of sample lines are measured and averaged by calculation with the Adam microprocessor. The HIGH and LOW set-points are programmed into the Adam unit and the alarms will activate when the set-points are exceeded. See Table 2, *Alarm Setpoints*, for alarm setpoints. The high Offgas duct flow causes the automatic shut down of waste flow into the RK and SCC.

The Tank Farm sample flow rate is expected to be about 0.9 SCFM when the Tank Farm Exhaust flow rate is approximately 15 SCFM. The approximate 15 SCFM flow rate in the stack is based upon three continuous air monitors in operation at 5.0 SCFM per unit. During periods of tank venting, stack flow rate will likely double, and sample flow rate should also double in response to the higher flow rate. The listed flow setpoints are likely to change based upon these expected values.